A CLUSTER HOUSING SUBDIVISION

Alberta
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Innovative Housing Grants Program

A CLUSTER HOUSING SUBDIVISION

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FOREWORD

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EXECUTIVE SUMMARY

The purpose of this study is to investigate the social and economic aspects of applying a cluster housing concept, originally developed as an in-fill housing solution, to large scale suburban subdivisions. The original in-fill cluster was developed by C.P.C. (Community Planning Consultants Limited) and Peter Pratt Architects Ltd.

The methodology used in the adaptation of the cluster concept to large scale urban subdivisions was to firstly review and modify the original cluster concept to better meet the needs of the suburban setting. This involved additional space for two-car garages, enlarged floor areas and architectural modifications to reflect greater individual style. Next, several cluster units were designed reflecting diversity in the number of dwelling units per cluster and in the overall shape and dimension of the cluster form.

A conventional subdivision plan was used as the control factor upon which was overlain the various cluster concepts developed in the first and second step. Fourthly, analysis was performed to determine the relative yield and servicing efficiencies of the conventional subdivision compared to the cluster concept subdivision. The fifth step was to place the developed concept before the City of Calgary Planning, Engineering, Transportation, Parks and Recreation and Fire Departments for

their review and comments. Concerns and recommendations for improvement were then documented. Lastly, the concept was placed before developers from the private sector, again comments were solicited and documented. All of this input was then summarized in the main body of the report.

The key issues raised in the work were:

1. The social and aesthetic quality of the neighborhood
2. The usability of open space
3. The cost of roadways
4. The cost of utilities
5. Flexibility of housing development types
6. Acceptability to planning approving authorities
7. Traffic flow patterns
8. Marketability

The main findings were:

1. The social and aesthetic quality of the residential neighborhood was generally upgraded. On a social level some communities composed of dwellings within a particular cluster group may readily be established thus promoting the neighborliness of the neighborhood.
2. The hierarchy of open space both private and public can be readily identified within the immediate vicinity of individual dwelling units. There is a marked improvement

in utility of open space.

3. Construction of public roadways was reduced by 34% in comparison to the conventional subdivision. Paved areas internal to the cluster development, however, offset the saving in public roadway construction and resulted in an overall increase in paved surface costs of 18%.

4. The costs of major underground utility installation in the public regime was reduced by 57% in the concept. Again, however, added components within the cluster unit itself off-set this saving and cost of servicing and resulted in an overall increase of 9.7%.

5. In general, the flexibility of housing development types, was enhanced under the concept. Common restrictions of dimensions of lot width and depth can be layed aside and housing forms fit together in a manner enhancing their architectural characteristics. Lot dimensions can then be planned around the unit locations to develop private space and access requirements.

6. Acceptance by planning approval authorities was in general good. The most significant concern raised by planners was the governmental aspect of maintaining public utilities and open space. The Bare Land Condominium Act finds an obvious application to this form of development.

7. Traffic flow patterns are improved under this form of design. Access to dwelling units is limited to areas designed as such within the cluster unit itself. Movement between cluster units and outside destinations is enhanced by the more clearly defined use of collectors and arterials. On street parking is minimized if not eliminated.
8. Marketability as measured by developer acceptance was generally high provided that adequate care and control was exercised.

CONCLUSION

The cluster concept applied to large scale subdivisions is found to be workable and generally acceptable to both approving authorities and members of the development industry. Significant differences are achieved in the configuration of open space, the overall length of roadways, orientation of dwelling units and the privacy aspect within the neighborhood. Costs of servicing this type of development is somewhat higher but may be off-set by the potential of public appeal. While this study is not exhaustive it does indicate that the cluster concept is worthy of further development and implementation.

1. INTRODUCTION

The purpose of this study is to investigate the social and economic aspects of applying a cluster concept developed by C.P.C. (Community Planning Consultants) Ltd. and Peter Pratt Architect Ltd. on a large scale.

This cluster housing concept was originally developed as an in-fill housing solution.[1] The research work by C.P.C. reviewed past innovative housing and development concepts implemented by the City of Calgary as experimental housing projects in the recent decade. This work reviewed alternative built-forms and cooperative cost advantages. Legal ownership issues were described and the then current range of housing in Calgary relative to affordability was investigated.

C.P.C. then examined Calgary's existing housing market range of options from single-family, duplex, townhouse and cluster housing forms. Thereafter a number of proposed alternative land use and built form concepts were examined on a site area of 18,000 sq.ft. (comprised of three 50' lots having 120' depth). The alternative concepts were then reviewed and compared with existing City of Calgary Development Guidelines and

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1. This work is documented in a report entitled Cluster In-Fill Concept and was assisted under the Innovative Housing Grants Program in 1981.

studied as to implications and limitations within the framework of existing Calgary Zoning By-law constraints. Finally, each alternative was developed with possible servicing schemes and examined in a preliminary way as to comparative costs.

C.P.C. then selected the most favorable concept and refined it from a planning perspective in terms of land use and architectural design. The results were then reviewed against other development options.

To implement this cluster in-fill concept required further investigation of the legal implication of ownership. The investigation indicated that the cluster would require marketing based on a condominium ownership form. The best method of giving entitlement was indicated to be the land condominium approach found in B.C. and Manitoba.

This study examines the social and economic viability of applying the cluster housing concept to large scale urban residential developments, and attempts to test its feasibility and marketability in light of the recent approval of bare land condominiums in Alberta.

Chapter 2 reviews the in-fill cluster concept and adapts this basic cluster for use in large scale subdivisions. Chapter 3 presents comparable conventional and cluster subdivisions. Chapter 4 evaluates the cluster housing subdivision. Chapter 5 presents conclusions.

2. ADAPTING THE CLUSTER

This chapter adapts the cluster housing concept for use in large scale neighbourhoods and presents various cluster arrangements.

2.1. The In-Fill Cluster

In the process of plan development, it was decided to begin with the basic building block of the cluster in-fill design developed by Community Planning Consultants Ltd. and Peter Pratt Architect Ltd., which was an 8-unit semi-detached development form utilizing a 0.167 ha. building site consisting of three 50' x 120' lots.

Its main attributes are summarized below:

(a) While retaining its single-family character, the cluster concept enabled a density increase of two units over the conventional 25' narrow split-title approach then common in Calgary, yet does not give the feeling of apparent density increase.

(b) Through this marginal increase in density and the clustering form of layout, the concept allowed cost advantages and a competitive selling price in the (then) current in-fill market.

(c) By the comparative cost benefits that were indicated, the cluster concept appeared to enable penetration of the affordability threshold in the in-fill context and thus create a previously untouched market demand.

(d) By effective and efficient use of both exterior and interior space, the concept minimized inefficient and costly circulation space.

(e) The cluster approach with good built-form design enabled a pleasing relationship of the house interior to an hierarchy of different types of usable open space.

(f) The layout and overall landscape design gave the concept its desired singular ownership character with low maintenance of common areas.

(g) The effective integration of common usable space provided more efficient recreational areas, a safer flow of pedestrian circulation, enhancing security of family members.

(h) The cluster approach was deemed to maximize the family life style through small neighborhood enclaves, while also supporting diversity and range of life styles both family and individual mix. The cluster approach was

further perceived to create a 'mini-neighborhood within a neighborhood' to thus promote communal feeling and common awareness in all communities.

2.2. Approach to Cluster Modification

In order to develop a suburban context, a theoretical parcel of 160 acres was conceptualized. A 40 acre quadrant of this was then selected and the in-fill cluster applied to this area. Knowledgeable land developers then commented as to practical applicability and market acceptance. Suggestions included:

(a) additional space for two-car garage;
(b) additional space for two-car movement;
(c) enlargement of floor area to over 1,200 sq.ft.;
(d) substantially 3 bedroom units with en suite;
(e) full utilization of basement for improvement and use;
(f) roof-line and elevations reflecting greater individual style.

Modifications in the cluster form were then examined in light of this feedback and adaptations were made in response to prevailing suburban market demands. Flexibility in housing forms was introduced and amenities within the cluster were enhanced to meet expected consumer demands. Next, variations in cluster sizes were introduced to improve efficiency and flexibility in adaptation to the land form itself.

While it is impossible to present an exhaustive survey of the cluster potential for flexibility and variation, we have included the following examples of these potentials and a brief description of their features in Figures 2-1 to 2-4.

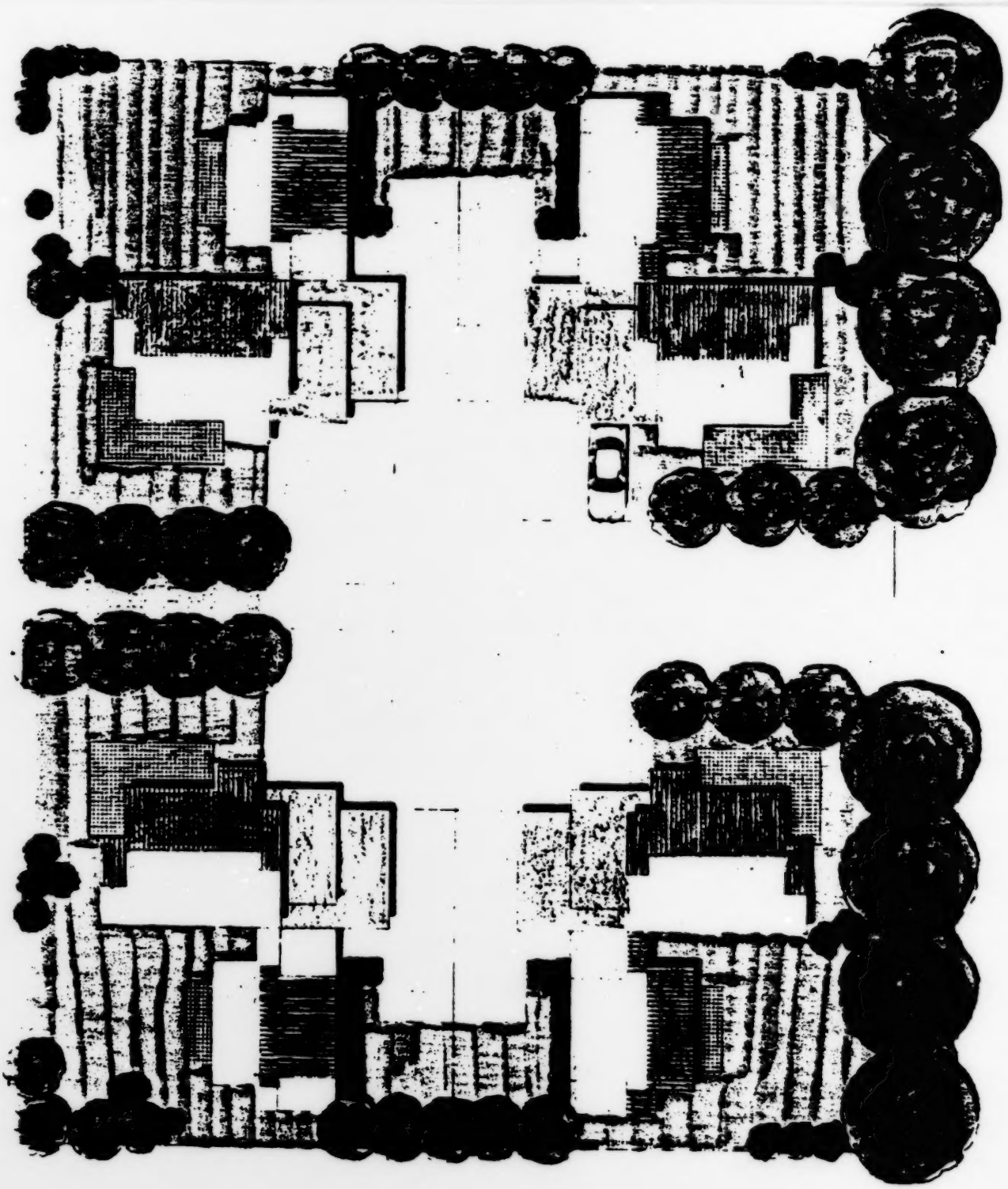

Fig. 2-1: 8-UNIT SEMI-DETACHED CLUSTER

DESCRIPTION OF FEATURES

8-UNIT SEMI-DETACHED CLUSTER

- Cluster dimensions are approximately 50 m x 40 m = 2,000 sq. m.
- Single car garages are illustrated with parking for two cars per unit within the lot.
- Internal roadway standards are insufficient for fire truck or garbage-truck access based on existing municipal standards. However, the cluster dimensions are such that fire hoses can easily reach all units from outside of the cluster. With maneuvering, shallow utility units can turn around in this cluster.
- The lot area for each semi-detached lot is approximately 430 square meters or 4,629 square feet (an average of 2,313 square feet per unit).
- The area of public roadway and walkway within the cluster is approximately 280 square meters.
- Privacy is enhanced - particularly for units which are recessed.

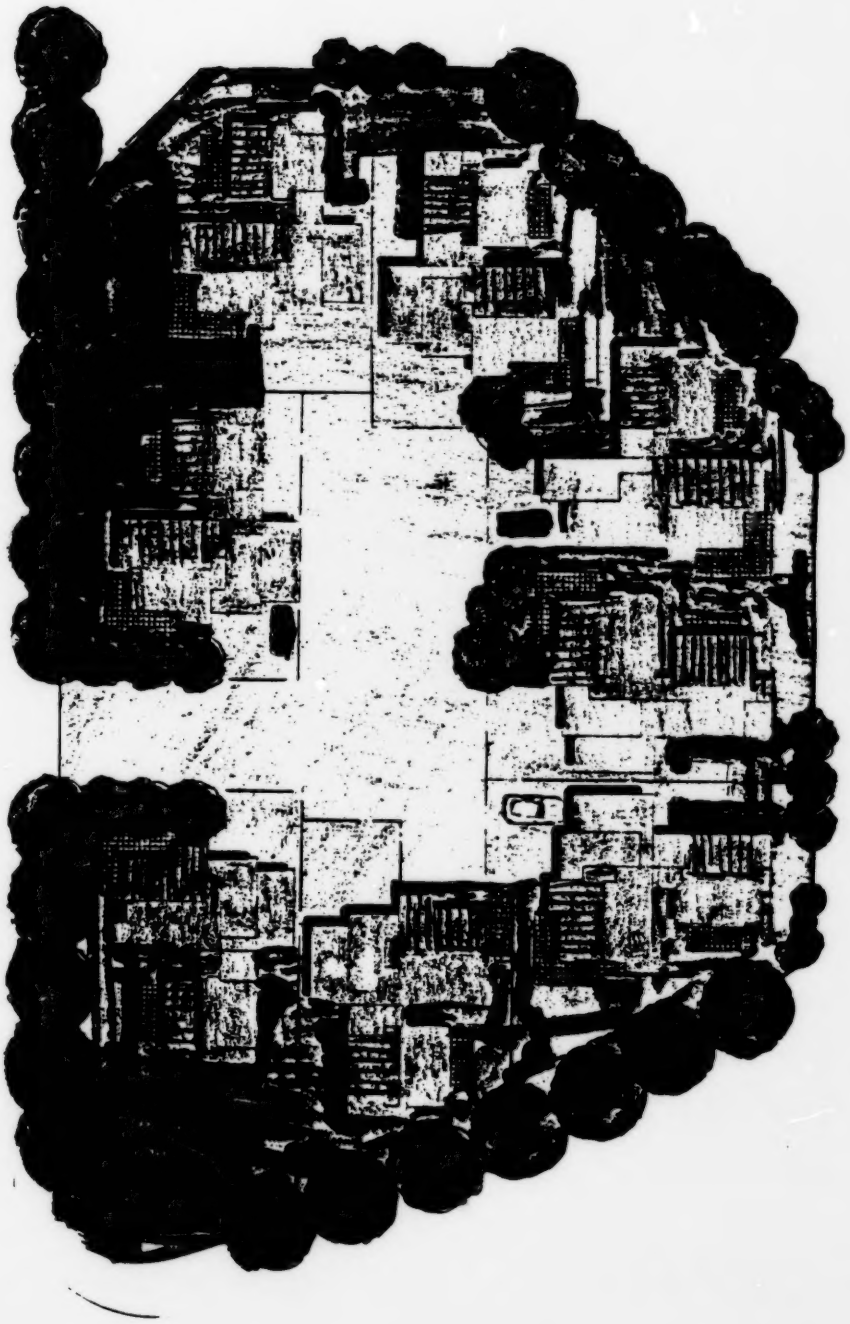

Fig. 2-2: 16-UNIT SEMI-DETACHED CLUSTER

DESCRIPTION OF FEATURES

16-UNIT SEMI-DETACHED CLUSTER

- Cluster dimensions can be varied to suit the size of land parcel available. For the configuration shown, the approximate cluster dimensions are 84 m. x 55 m. The actual cluster area is 4,076 square meters.
- The public roadway area is 590 square meters.
- The net area is 3,486 square meters.
- The average lot size is 217.88 square meters or 2,344 square feet. The actual lot size varies depending on the location of the unit within the cluster.
- A S.U.* vehicle can turn around on public roadways within the cluster with only one maneuver required.
- Privacy is enhanced for those units which are recessed.
- Room for additional parking is available on public roadways within the cluster while still allowing room for a S.U. vehicle to maneuver normally.
- Servicing efficiencies increase over that of the 8-unit semi-detached cluster.

* Single unit vehicle of up to 9.1 metres in length.

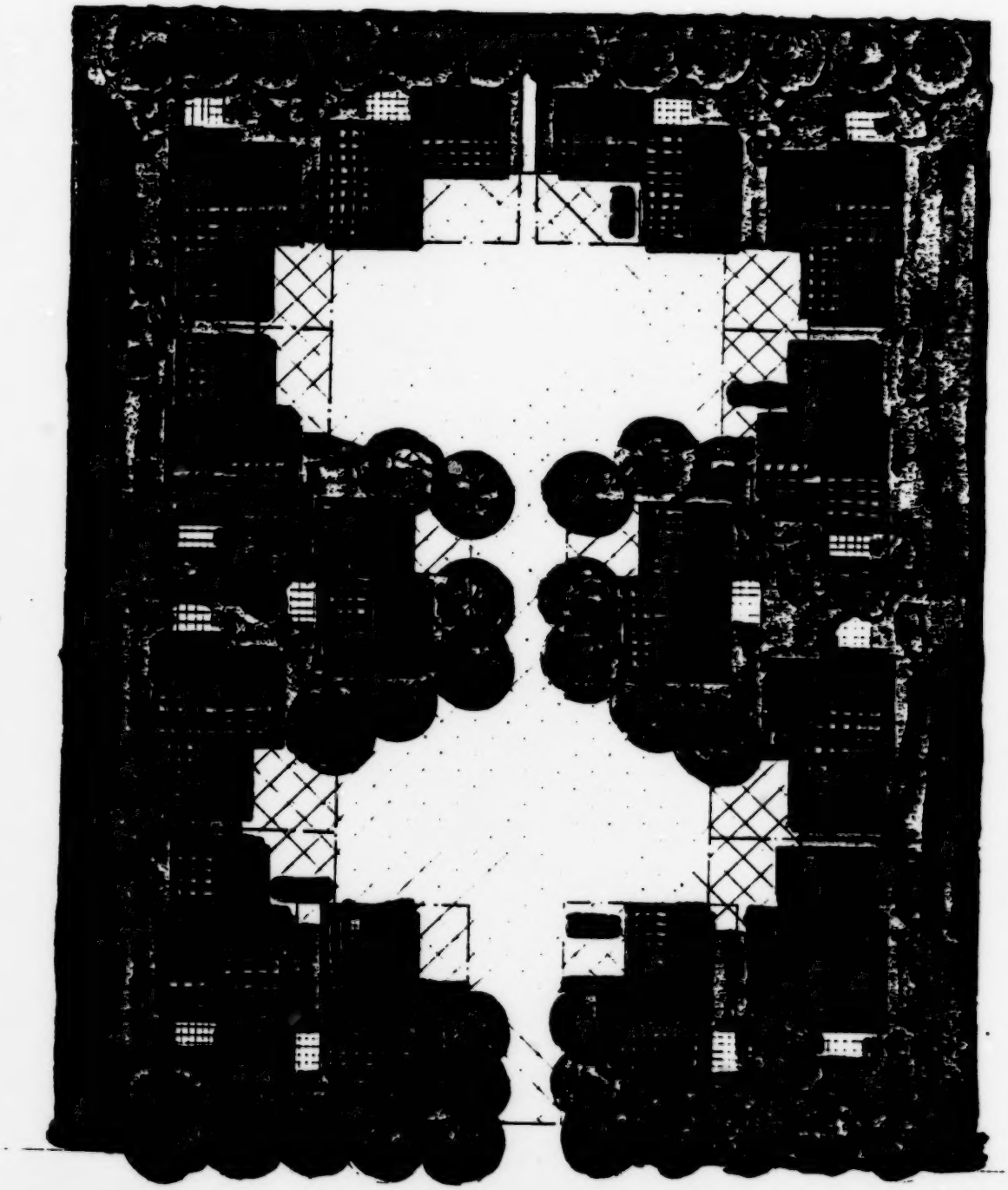

Fig. 2-3: 8-UNIT SINGLE-FAMILY CLUSTER

DESCRIPTION OF FEATURES

8-UNIT SINGLE-FAMILY CLUSTER

- Cluster dimensions can be varied to suit the size of the land parcel available. For example, we have three concepts of this cluster which can work efficiently.
- The cluster dimensions as illustrated are 55 m. x 77 m.
- Public road standards in this cluster are such that a P* vehicle can maneuver comfortably. A S.U. vehicle would require one maneuver. A minor adjustment to the cluster lot dimensions could provide adequate turning radius for a S.U. vehicle.
- The total cluster is 3,874 square meters
- The public roadway and walk-way area is 708 square meters
- The net area of lots is 3,166 square meters
- The average area per lot is 396 square meters.
- Privacy is enhanced particularly for those units which are slightly recessed.
- All units as illustrated have double garages and parking off the public roadways for four vehicles in total.
- Numerous different housing units could fit comfortably in this cluster scheme.
- Cluster dimensions can be increased to increase lot sizes.

* Passenger Vehicle of up to 5.8 metres in length.

- The centralized public right-of-way area is ideal for a tots playground with good visibility of this area from each of the units.

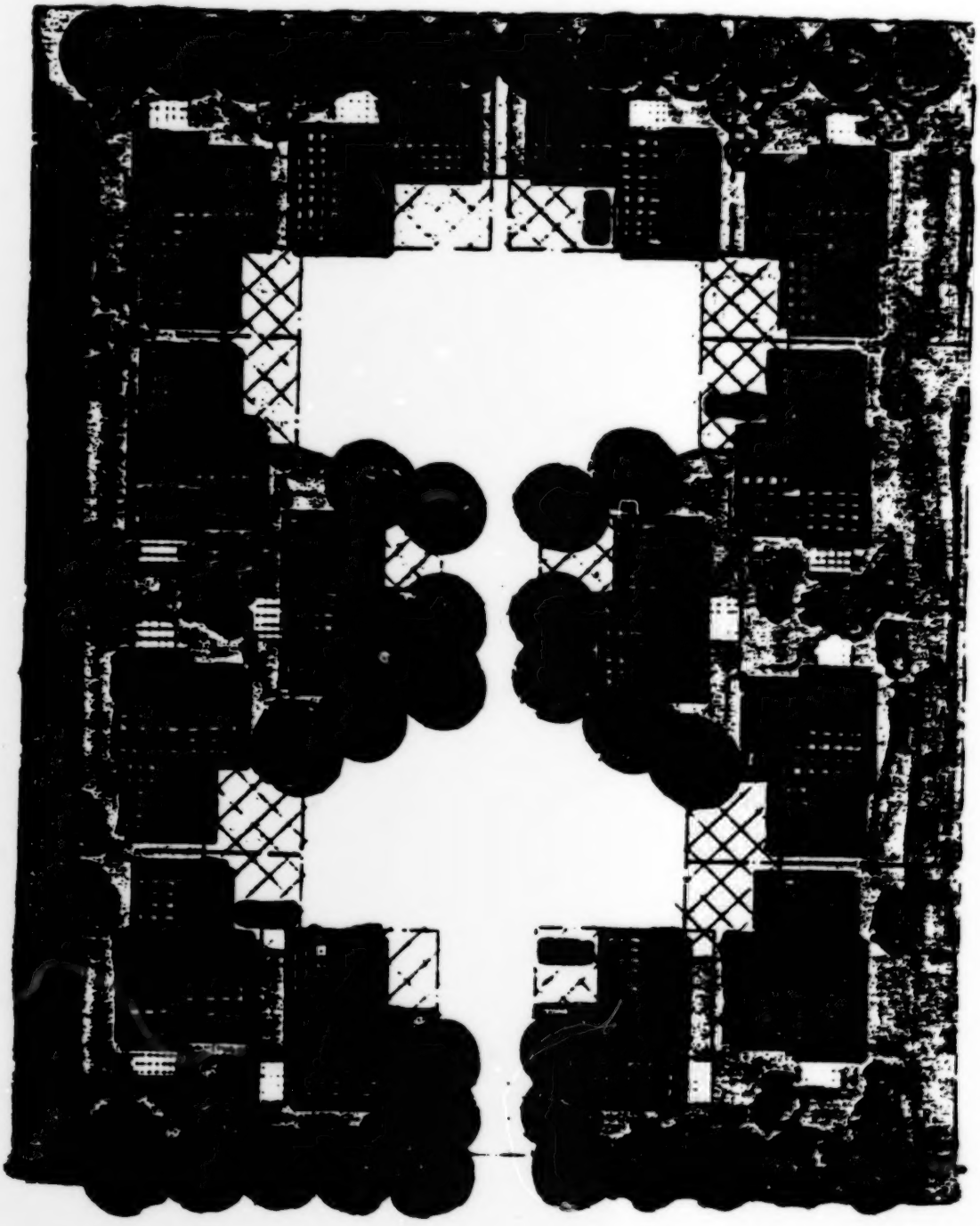

Fig. 2-4: 14-UNIT SINGLE-FAMILY CLUSTER

DESCRIPTION OF FEATURES

14-UNIT SINGLE-FAMILY CLUSTER

- The cluster dimensions can be varied somewhat to suit the size of the land parcel available. The cluster can be expanded in width or length to accommodate four additional units, but with some efficiencies lost. This cluster does not have to be rectangular - this is only one version of it.
- The approximate cluster dimensions are 77 m. x 94 m.

for a Total Area of	-	7,238 square meters
Public Roadway and Walkway Areas	-	1,483 square meters
Net Area		5,755 square meters

Approximate Area/Lot =5,755/14 = 411 square meters (4,423 square feet)

Numerous features in this cluster are the same as for the 8-unit single-family cluster, including:

- The public road standard in this cluster is such that a P-vehicle can maneuver comfortably. A S.U. vehicle would require one maneuver. A minor adjustment to the cluster lot dimensions could provide an adequate turning radius for a S.U. vehicle.

- All units as illustrated have double garages and parking off the public roadways for four vehicles in total.
- Privacy is enhanced for those units which are slightly recessed.
- Numerous different housing unit types could fit comfortably in this cluster scheme.
- The centralized public right-of-way areas are ideal for tot playgrounds with good visibility of this area from each of the units.
- If desirable, the cluster dimensions can be increased to increase the single-family lot sizes within the cluster. Thus "Estates" sized lots could be developed under this same concept.

3. COMPARISON OF A CLUSTER CONCEPT WITH A CONVENTIONAL PLAN

In developing a concept plan which utilizes the cluster housing concepts as modified, to reflect suburban lifestyle demands, it was decided to overlay an existing fully developed conventional subdivision of suitable dimensions and thus allow direct and meaningful comparisons to take place. In so doing, it was decided to maintain an approximately equal mix of housing unit types as exist in the conventional development and to maintain approximately equal overall density. Thus the market conditions met in the actual conventional development are held to apply to the cluster concept.

3.1. Description of Conventional Subdivision

The conventional subdivision (Figure 3-1) chosen to act as the control model for the study consists of 15.4 ha. (38 acres) net of the mandatory 10% reserve dedication of suburban residential lands with the following yield:

Table 3-1: YIELD - CONVENTIONAL SUBDIVISION

- Site Area (net of 10% reserve) - 15.4 ha. (38 ac.)

Single Family Detached	-	136 dwelling units
Semi-Detached	-	12 dwelling units
Fourplex	-	36 dwelling units
Multi-family	-	108 dwelling units
Total	-	292 dwelling units

- Estimated Population - 830 persons

- Gross Population Density - 19.7 p.p.a.

Roadways	-	1,910 L.M. (6,266 L.F.)
Laneways	-	1,680 L.M. (5,512 L.F.)
Internal Open Space	-	0.429 ha. (1.06 ac.)

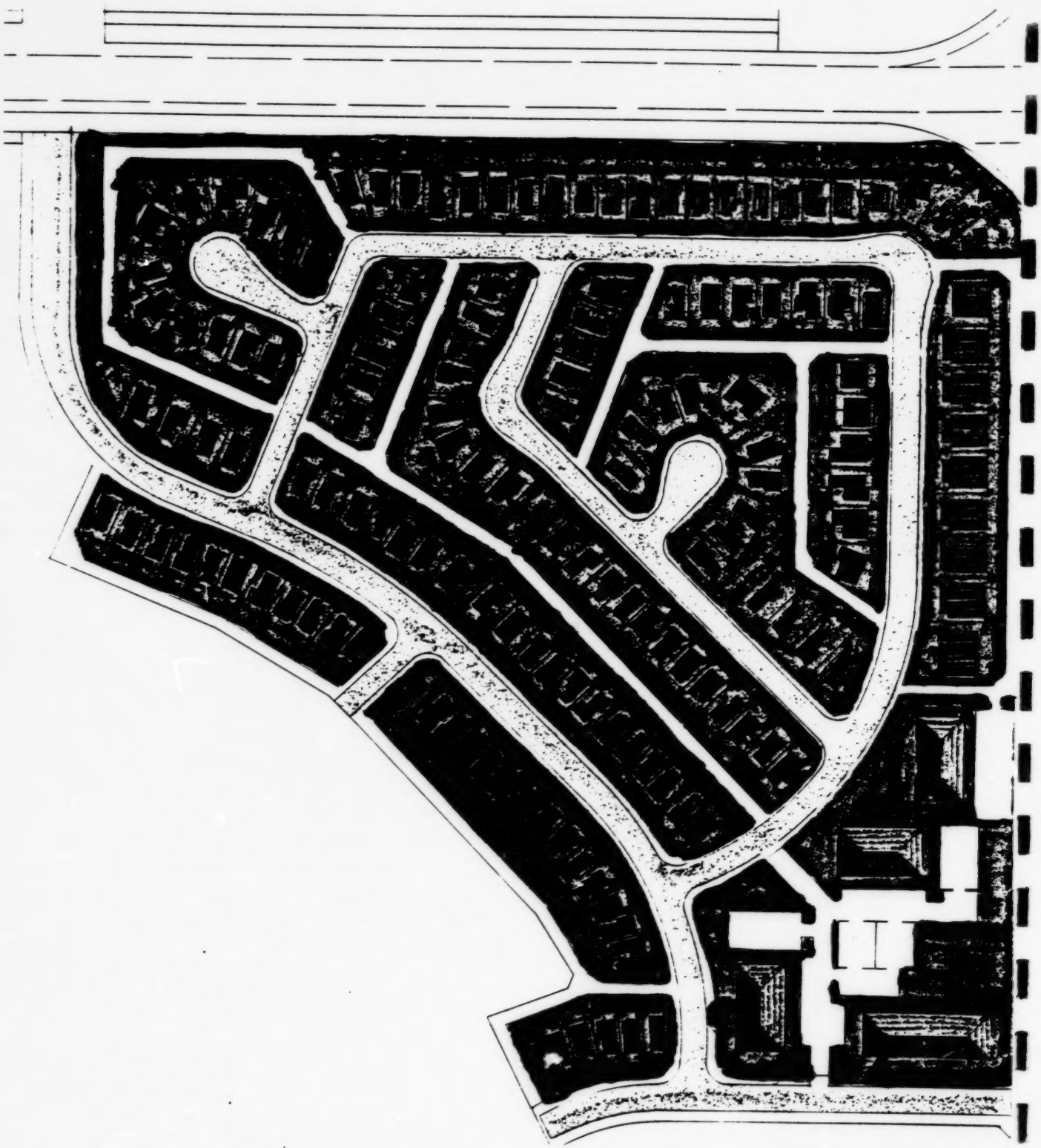

Fig. 3-1: 40 ACRE CONVENTIONAL SUBDIVISION PLAN

3.2. Overlaying the Cluster Concepts

In using the modified cluster concepts developed in the previous section, it was found that an alternative approach to the planning process was possible. Whereas in conventional planning procedures, much thought is given to the location of roadways, the configuration of the 10% reserve dedication and lastly the size and configuration of the lotting scheme , it was found that in planning a cluster development it was practical to position the clusters first, paying attention to land form, the internal interrelation of open space and lastly, to the roadway configuration. Because the cluster design itself is a product of housing form, the hierarchy of private open space around the individual units and the creation and orientation of access within the cluster, we see that the clustered subdivision is designed in a logical progression beginning with the dwelling unit and progressing in a hierarchy of land use to the finished product. This is significantly different from the conventional approach which leaves the industry adapting housing forms to an established and restrictive lot size and shape. This reversal in priority opens up new options in the treatment of land use and its relationship to the dwelling unit situated on it. The dwelling

unit and its immediate environment now take first priority and the infrastructure of utilities, roadways and open space is designed around it in a manner optimizing their relative functional uses.

In developing the cluster concept overlay, (Figure 3-2), attention was given to maintaining a similar housing unit built form and to maintaining a comparable housing unit (and population) density to that of the conventional subdivision used as the control model.

The cluster concept subdivision yields the following statistics:

Table 3-2: YIELD - CLUSTER CONCEPT SUBDIVISION

- Site Area (net of 10% reserve dedication) - 16.01 ha. (39.6 ac.)

Single Family	-	162 dwelling units
Semi-Detached	-	32 dwelling units
Fourplex	-	0 dwelling units
Multi-Family	-	108 dwelling units
Total		302 dwelling units

- Estimated Population - 880 persons
- Gross Population Density - 20 p.p.a.

Roadways	-	1,373 L.M. (4,505 L.F.)
Laneways	-	0 L.M.
Internal Open Space	-	1.96 ha. (4.84 ac.)

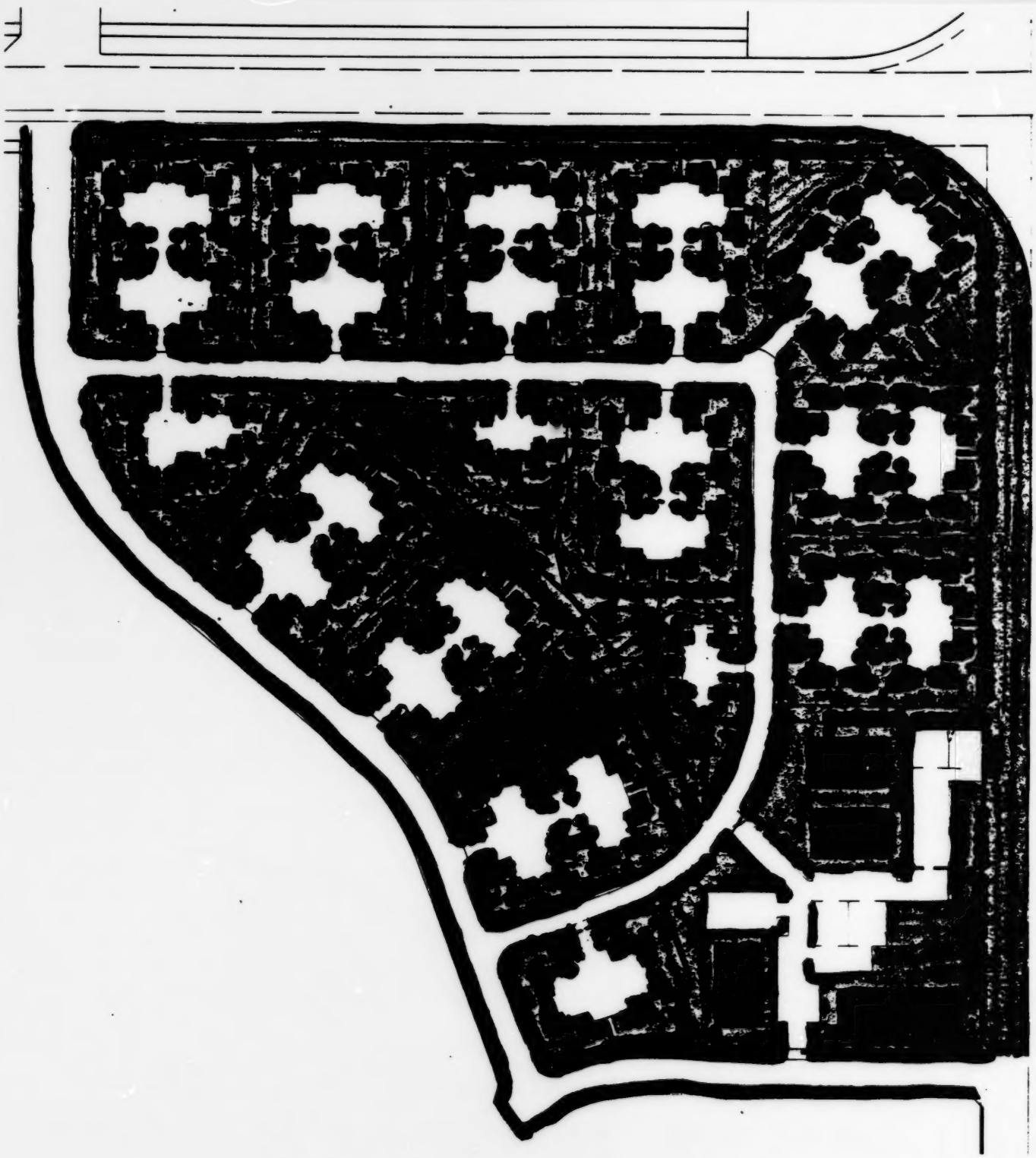

Fig. 3-2: Cluster Concept Plan

4. EVALUATION OF CLUSTER SUBDIVISION

This section evaluates the large scale cluster concept developed in the previous section against the following criteria:

1. To enhance the social and aesthetic quality of residential neighbourhoods.
2. Enhance the quality and usability of open space.
3. Reduce cost of roadways.
4. Reduce cost of utilities.
5. Provide flexibility of housing development types.
6. Prove acceptable to planning approval authorities.
7. To improve traffic flow patterns.
8. Be marketable as measured by developer acceptance.

4.1. Social and Aesthetic Qualities of Neighbourhoods

The cluster concept provides opportunity for significant improvements in the social and aesthetic quality of residential neighbourhoods. The cluster itself becomes a social center comprised of a limited and manageable number of family units. A sense of community is developed within the cell. An owner's neighbours become those with whom he shares a sense of community within the individual development cluster - an extension of those social aspects already identified within the cul-de-sac concept of a conventional subdivision.

In the conventional subdivision, a social unit attempts to establish itself along a street, within a block, or within a cul-de-sac. The boundaries of this unit are not easily defined, resulting in a loss of identity to the social set. Social units tend to be fragmented and have difficulty establishing an identity. The cluster concept, as in the conventional cul-de-sac design establishes the bounds of these sub-communities and enhances opportunity for social development within the development cell.

The architectural design conditions promote a return to a lateral configuration of the dwelling unit itself, thus promoting the single-family neighborhood concept which is so much a part of our North American cultural heritage. The fact that unit density within the cluster is in fact increased is off-set with the greater provision of common open space. Lot sizes remain essentially unchanged and range from 3,100 sq.ft. to 5,100 sq.ft. in the single family clusters.

On a social level, the owner/occupant enjoys the use of private space adjacent to his dwelling unit and has ready access to larger open space for passive as well as active recreational uses. A sense of ownership is developed for those open spaces bounded by a grouping of clusters and opportunities for social interaction are enhanced.

The use of space and orientation of built-form are greatly significant factors in social development within a neighbourhood. The cluster concept applied to large scale developments provides increased opportunity for development and enhancement of these critical features.

4.2. Quality and Usability of Open Space

The design of open space for private use in the immediate vicinity of the dwelling unit is a controlled amenity affected by the architecture and positioning of adjacent units. This feature becomes a conscious aspect of the architectural control process.

The correct orientation of architectural features within the dwelling unit itself will provide the necessary privacy both internally and externally. Special attention must be paid to the location of decks and patios to maximize utility of

exterior private spaces. Windows and doors of adjacent dwellings should be located with sensitivity to adjacent spaces to maximize privacy of neighbouring properties. Deliberate architectural control by the land developer is recommended for this type of development to maximize these favorable attributes.

Access to common and public open space is enhanced through the rear yard orientation of a greater number of units to open space amenities.

Open space, whether common or public, may be created in addition to the 10% required under the Planning Act. The cluster concept plan herein presented contains approximately 10% additional open space above that provided in the control model. Therefore, greater potential exists for creating meaningful passive parks, walkways and bicycle paths within immediate reach of individual dwelling units.

Open space in general is oriented away from traffic routes, thus minimizing potential pedestrian/vehicle conflict.

4.3. The Cost of Roadways

The length of public roadways is significantly reduced. The present study shows a 28% overall reduction in length of roadway occurring entirely in the local roadway sector. The collector roadway system remains basically unchanged in length.

Laneways are entirely eliminated as access to each dwelling unit is provided on-site in front of unit.

A quantity take-off from the comparative concept designs of Figure 3-1, "40 Acre Conventional Subdivision Plan" and Figure 3-2, "Cluster Concept Plan" for hard surface improvements within public roadways yields:

Table 4-1: ROADWAYS QUANTITY COMPARISON

	Conventional Subdivision (Figure 3-1)	Cluster Subdivision (Figure 3-2)
Monolithic Sidewalk	3,320 l.m.	-
Separate Sidewalk	97 l.m.	1,250 l.m.
Curb and Gutter	572 l.m.	3,189 l.m.
Asphaltic Pavement		
- Primary Collector	1,360 s.m.	1,360 s.m.
- Local Collector	12,719 s.m.	7,750 s.m.
- Local Residential	9,222 s.m.	6,555 s.m.
Graveled Lanes	10,500 s.m.	-

The above table indicates an overall reduction in the quantities of the public roadway construction components of 47%. A cost comparison yields the following:

Table 4-2: ROADWAY COST COMPARISON

	Conventional Subdivision (Figure 3-1)	Cluster Subdivision (Figure 3-2)
Sidewalks, Curbs & Gutters	$234,022	$169,100
Pavement	$527,100	$338,100
	$761,122	$507,200

The cost of construction of public roadways is reduced by $254,000 or 34%. While the cost of development of public roadways is significantly reduced as indicated in the above tables, it is important to note that the cluster concept implies significant pavement surfaces within the clusters themselves. In the example illustrated in Figure 3-2, the internal pavement amounts to 19,627 m at an estimated cost of $394,000.00. While this quantity does not apply to public roadways, it is a significant component of the total development cost of the completed development and therefore a significant component in the valuation of the finished product. Whereas the cost of public roadways is significantly reduced, the overall cost of surface pavements is increased by $140,078 or 18%.

4.4. The Cost of Utilities

Servicing patterns for underground public utilities are significantly simplified as each cluster becomes a serviced unit development. Routing patterns are simplified in a similar manner to roadway patterns.

In the same manner as above, a quantity take-off and cost comparison was done comparing the Cluster Concept of Figure 3-2 with the Conventional Design of Figure 3-1. The following table compares the public utility portions of the develcpment.

Table 4-3: UTILITY QUANTITY COMPARISON

	Conventional Subdivision (Figure 3-1)	Cluster Subdivision (Figure 3-2)
Sanitary Sewers	2,315 l.m.	1,289 l.m.
Sanitary Manholes	32	7
Storm Sewers	2,409 l.m.	1,276 l.m.
Storm Manholes	39	7
Watermains	2,647 l.m.	1,377 l.m.
Service Connections	1,482 l.m.	-
Cost of Public Utilities	$1,205,097	$519,000

An overall cost reduction of 57% for public utilities.

As with the surface pavement reported in 4.3 above, a significant component of the cluster concept is the on-site private utility component from the street mains to the units themselves. In the case of Figure 3-2, those added components are as follows:

Table 4-4: ADDED UTILITY COMPONENTS

Sanitary Sewers	1,108 l.m.
Sanitary Manholes	42
Storm Sewers	1,100 l.m.
Storm Manholes	42
Watermains	1,596 l.m.
Service Connections	2,032 l.m.
Cost of Construction	$802,855.00

Therefore, whereas the cost of public utilities is significantly reduced, the overall cost of servicing the units is increased by $116,758 or 9.7%.

4.5. Flexibility of Housing Development Types

Cluster design allows a variety of housing types and does not constrain the development of individualistic design of the built-form. Flexibility can be expressed through varying the cell dimensions, the number of units within a cell, the configuration of the units, the orientation towards adjacent open space, as well as the individual character of the built-form.

As expressed earlier, the evolution of the plan layout begins with a conceptualization of the housing form to be ultimately built within the development. These units are then arranged in clusters with special attention paid to the privacy aspects of exterior and interior space, as well as the interrelation with adjacent units. Thus having established the cluster unit, the cell is then super-imposed on the site plan and integrated with other features. With this ability to deal with the housing type and structural form at the outset of the planning process, the designer is able to incorporate a wide variety of housing types depending upon market demand.

Conventional subdivisions are largely constrained to rectangular lotting patterns in linear or curvilinear formations. Traditionally, housing forms were designed to fit specific lot dimensions, thus limiting design flexibility. The cluster concept eliminates this constraint as the 'lot' can be designed to fit the requirements of the dwelling unit and then be integrated into the cluster.

Figures 2-1, 2-2, 2-3 and 2-4 illustrate varying housing types, lot dimensions and their inter-relationships. Figure 3-2, further illustrates the ability to mix housing types from cell to cell, giving continuity within the cluster grouping itself while mixing housing types on the larger scale.

4.6. Planning Approval Authorities

A meeting to review the cluster concept was held with members of the City of Calgary Planning, Engineering, Transportation, Parks and Recreation and Fire Departments. Their concern and comments are summarized as follows:

(a) How are the open spaces greater than the 10% requirements to be dedicated? The City would be unwilling to purchase the extra space but would likely agree to maintain the entire park system as a trade-off to reduced streets and utility maintenance and the acquisition cost of the additional space.

(b) Garbage pick-up: the City crews will not enter the private space and will require common garbage pick-up for collection. A possible solution would be contracted garbage collection by the condominium association.

(c) Land Use Designation: Must recognize the form of development undertaken not the form of ownership. In Calgary, the existing RS1 designation would be appropriate for the single-family housing type. Other designations such as DC would be applicable for more complex housing forms.

(d) Provincial fire statutes require a minimum 30 ft. driving surface for fire-fighting equipment access. The cluster concept can accommodate these requirements.

(e) It is recommended that provision be made for storage of recreational vehicles by means of a secure enclosure separate from the cluster units themselves.

(f) Would the Bare Land Condominium concept be applied cluster by cluster or to the community as a whole? It is conceivable that condominium unit may consist of those units which comprise the individual cluster unit. Alternately, the entire neighborhood may comprise the condominium association and manage all of the common areas as a combined unit. The management and maintenance of the development would be significantly different in the above two scenarios.

(g) Common Open Space: Consideration would be given to the concept of a hierarchy of open spaces. Those common open spaces which would be controlled by a Community Condominium Association vs. the open space adjacent to each cluster being owned and operated by a Neighbourhood Condominium Association. Both Associations may be integrated for cost sharing and operating control.

(h) Public road right-of-ways must be designed and built to full City standards.

(i) Walking distances to transit pick-up points must be considered. The farthest optimum distance being approximately 450 m.

(j) Reduction in length of total road right-of-way and higher on-site development densities will require consideration of storm detention within the individual cluster. The designer must consider the comparative balance of hard surface vs. open space to meet storm drainage needs.

(k) Consider water supply shut-off valves for each cluster as a means of control at entrance to private lands.

(l) Consider a manhole at exterior property line for each sewer for inspection and maintenance services.

(m) Access to cluster must be maintained for fire protection services. Primary gates are not recommended at the entrances to clusters.

(n) Cluster concept provides a simplified routing for emergency vehicles wishing access to particular dwellings.

In general, while this type of development will require close scrutiny during its initial years of production, the concept appears workable. The above considerations may be integrated into the concept without significant modification to design.

4.7. Traffic Flow Patterns

Access to individual dwelling units is fully internalized within the cluster cells; no units access directly to streets.

Traffic patterns are routed away from the dwelling units. Streets become structures for vehicular traffic, not parking lots or driveway access devices. This greatly simplifies street functional uses and significantly reduces vehicular and pedestrian conflict potential.

The length of public roadways is significantly reduced. The present study shows a 28% overall reduction in length of roadway occurring entirely in the local roadway sector. The collector roadway system remains basically unchanged in length. As noted earlier, the fact that unit access is entirely encompassed within the cell boundaries, results in a significant reduction, if not elimination of the projected occurrence of on-street parking. Therefore, the street will become more functional and risk of accidents will be substantially reduced. The impact of traffic volume on residential comfort levels of adjacent units will be substantially reduced as the orientation of all dwelling units is essentially off-street.

4.8. Marketablility as Measured by Developer Acceptance

The cluster concept was reviewed with Mr. D. Poppit, of Melcor Developments Ltd., of Calgary, and with Mr. A.G. McDonald of Cairns Homes Limited of Calgary. Both expressed interest in the concept and had prior experience along these lines. Their comments may be summarized as follows:

- Cluster housing concepts may be used in single-family format to achieve 22 persons per acre plus overall density.
- The acid test of value is in the re-sale marketplace. Cluster housing values have not suffered cost recession as much as conventionally designed styles.
- The concept is suitable for use in rugged topography where large environmental reserves are dedicated.
- Tot lots are placed in desirable locations and are used extensively.
- Walkways are planned to interface between open spaces and built forms.
- Roadways may be constructed to narrower widths due to their more efficient use.
- Cluster housing must provide off-street parking (200%) to adequately accommodate the use of vehicles in our colder climate.
- Lanes are a waste of space.

- Edge control is necessary on paved surfaces.
- Fencing control is necessary.
- Bare Land Condominium Subdivision is desirable for maintenance of additional open space and cluster unit common space.

In general, we have recieved a positive response from each industry developer which we contacted. Provided adequate care and control is exercised, market acceptance should be high.

5. CONCLUSION

The cluster concept applied to large scale subdivisions is found to be workable and generally acceptable to both approving authorities and members of the development industry.

Comparison of the conventionally designed subdivision (Figure 3-1) with the cluster concept plan (Figure 3-2) indicates that significant differences are achieved in the configuration of open space, the overall length of roadways, the orientation of dwelling units and the privacy aspects of the neighbourhood. More specifically, the cluster concept plan is significant in the following ways:

1. Cluster design allows a variety of housing types and does not constrain the development of individualistic design of the built-form. Flexibility can be expressed through varying the cell dimensions, the number of units within a cell, and the configuration of the units, to enhance the privacy aspects of adjacent open space, as well as the individual character of the built-form.
2. The design of open space for private use in the immediate vicinity of the dwelling unit is a controlled amenity affected by the architecture and positioning of adjacent units. This feature becomes a conscious aspect of the architectural control process.

3. Access to common and public open space is enhanced through the rear yard orientation of a greater number of units to open space amenities.

4. Access to individual dwelling units is fully internalized within the cluster cells; no units access directly to streets.

5. Traffic patterns are routed away from the dwelling units. Streets become structures for vehicular traffic, not parking lots or driveway access devices. This greatly simplifies street functional uses and significantly reduces vehicular and pedestrian conflict potential.

6. A sense of community is developed within the cell. An owner's neighbours become those with whom he shares a sense of community within the individual development cluster - an extension of those social aspects already identified within the cul-de-sac concept of a conventional subdivision.

7. Open space, whether common or public, may be created in addition to the 10% required under the Planning Act. The cluster concept plan herein presented contains approximately 10% additional open space above that provided in the control model. Therefore, greater potential exists for creating meaningful passive parks, walkways and bicycle paths within immediate reach of individual dwelling units.

8. The length of public roadways is significantly reduced. The present study shows a 28% overall reduction in length of roadway occurring entirely in the local roadway sector. The collector roadway system remains basically unchanged in length. As noted earlier, the fact that unit access is entirely encompassed within the cell boundaries, results in a significant reduction, if not elimination of the projected occurrence of on-street parking. Therefore, the street will become more functional and risk of accidents will be substantially reduced. The impact of traffic volume on residential comfort levels of adjacent units will be substantially reduced as the orientation of all dwelling units is essentially off-street.

9. Servicing patterns for underground public utilities are significantly simplified as each cluster becomes a serviced unit development. Routing patterns are simplified in a similar manner to road way patterns.

10. Laneways are entirely eliminated as access to each dwelling unit is provided on-site in a front of unit orientation.

11. Housing design may be laterally oriented with enclosed parking to the side of the unit as opposed to the linear orientation imposed by the narrower lots of a conventional development.

12. Lot sizes remain essentially unchanged and range from 3,100 sq. ft. to 5,100 sq. ft. in the single-family clusters.

13. The Bare Land Condominium Act is applicable and desirable in the development of this form of subdivision.

While this list is not exhaustive, it does indicate that the cluster concept is worthy of further development and implementation.